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EXCURSION GUIDES

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Phytogeographical Excursion to Mire Districts in North Sweden

July 22–August 7, 1950

By HUGO SJÖRS

SECTION: PHG

Phytogeographical Excursion to Mire Districts in North Sweden.

By *Hugo Sjörs.*

Introduction.

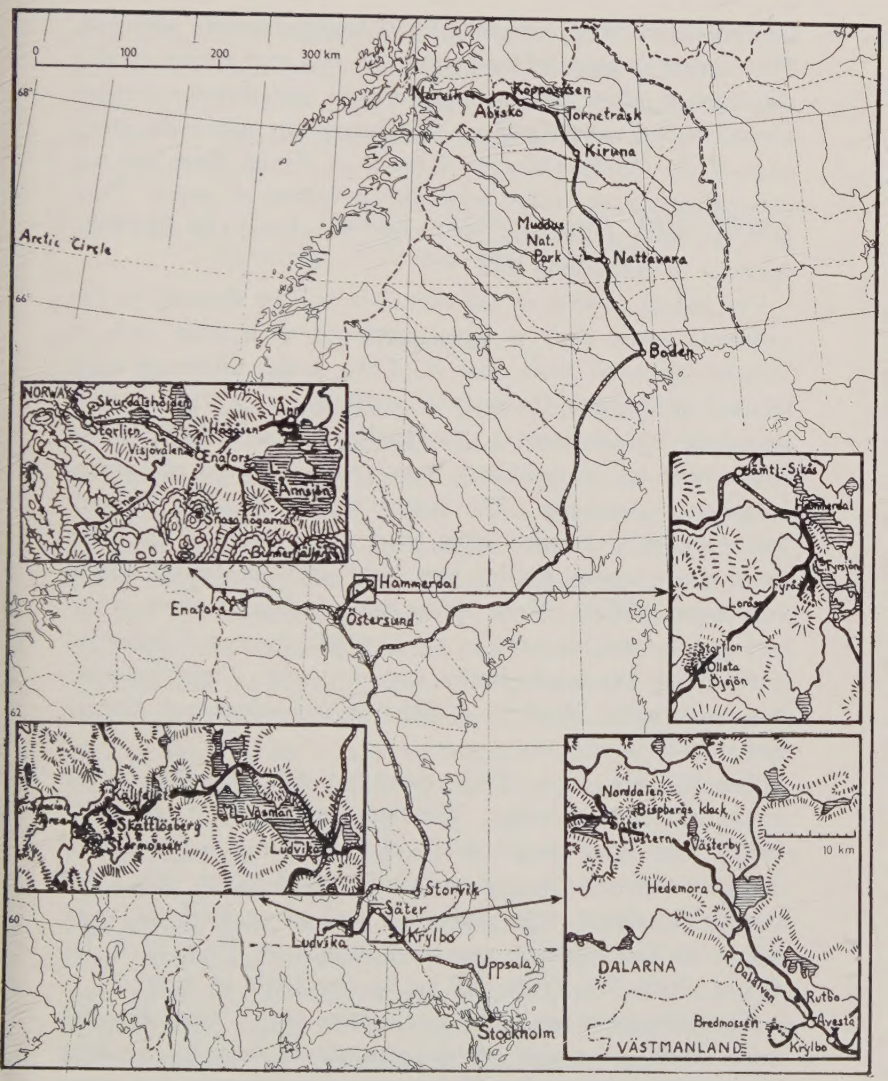
This little book aims to give some information about the places that will be visited during the course of the excursion, and is arranged chronologically. For discussion of the phytogeographical problems and for the terminology, the reader is referred to "Regional Studies in North Swedish Mire Vegetation", written by the author and cited in the text as SJÖRS 1950. For technical reasons, however, this guide had to be printed before the latter paper was worked out in detail, rendering direct reference impossible. For the first part of the excursion, in the province of Dalarna, reference is frequently made to "Mire Vegetation in Bergslagen, Sweden" (SJÖRS 1948, in Swedish, with an English summary). Much of the excursion, and of this guide, too, will be devoted to other kinds of vegetation than that of mires, as for instance, coniferous and deciduous forests, meadows, lake vegetation, and mountain vegetation.

The excursion will start in the lowland of E Sweden and will proceed, on the first day, to the valley of the river Dalälven, which is surrounded by hilly country. The uplands of the province of Dalarna will be visited on the third and fourth days. As is mentioned in short below (p. 8), the change

in flora and vegetation is very abrupt along the route of the excursion. This is illustrated, with respect to the prevailing types of mire complexes, by the contrast between the lowland mire Bredmossen of the first day and the upland mire Skattlösbergs Stormosse of the third and fourth. This contrast is, in the author's opinion, mainly due to the increase in humidity. Still more elevated and also more humid areas are situated to the west and north-west of the Skattlösbergs Stormosse, with the soligenous (sloping) fens quite dominating in the mire complexes. (These regions will not be visited.) — The ombrogenous mire parts (where the vegetation contains practically no plants needing supply of mineral soil water) are termed bogs or mosses. If plants known as indicators of mineral soil water are present, the mire part is termed fen. These concepts were distinguished in the senses accepted here mainly through the works of Du Rietz (most fully 1949). As acid fens, often very oligotrophic and poor in species (poor fens according to Du Rietz), are very common in Fennoscandia, the use of the word fen may often be rather unfamiliar to an Englishman, considering that most British fens correspond to certain varieties of our "rich fens".

From here the excursion will proceed to one of our most humid areas, that of W Jämtland. The mires around Enafors, esp. those of the hill Högåsen, are characteristic of this humid district. As is evidently the rule in a country with a large excess of precipitation, strongly sloping fens prevail on the sides of the hills, and mosses are extensive on the plateaus and in the flat valleys (esp. where the soil is permeable to water).

Most of the fens in Dalarna were non-calcareous; those of the Enafors district are, in the main, weakly calcareous (they seem to be more calcareous at Storlien). The following two days (July 30 and 31) will be spent in the very calcareous


0
100
200
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68°
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62
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Arctic Circle
Kappasen
Abisko
Torneträsk
Kiruna
Muddus Nat. Park
Nattavara
Boden
Hammerdal
Östersund
Enafors
Storvik
Säter
Krylbo
Ludvika
Uppsala
Stockholm
DALARNA
VÄSTMANLAND
Hedemora
Västerby
Rutbo
Avesta
Bredmossen
10 km
NORWAY
Skurdalshöjden
Storlien
Visjövalen
Enafors
Åmsjön
Sjoa
Hagarna
Bunnerfjällen
Gamtl-Sikås
Hemmerdal
Tyrsjön
Lorån
Storlon
Ollsta
Djupån
Norddalen
Bispbergs klack
Säter
Ljusterna
Kallfors
Skattlösberg
Stormossen
Vasman

Central Jämtland, covered by Cambro-Silurian deposits. The climate is moderately humid. In the vast plains slightly sloping fens, often with moss hummocks, cover very extensive areas. In the valleys and on the slopes, esp. along the steep edge of the Cambro-Silurian deposits at Fyrås, there are numerous springs and other more diffuse outlets of water. They feed the sloping fens and "tall herb" meadows, and also form deposits of calcareous tufa.

The fourth portion of the excursion will be devoted to the subarctic mires, such as have developed on a large scale in Muddus National Park, just N of the Arctic Circle (in spite of the high latitude, the climate conditions are not truly arctic anywhere in Scandinavia). Muddus has the form of a flat basin surrounded by some hills, a very typical feature of Central Lappland topography. The largest stands of primeval coniferous forest in Sweden grow there. The mires of the hilly country are mostly sloping fens (with very interesting spring vegetation locally). Those of the central plain are very extensive and, in part, covered by the peculiar complex of damming moss (bog) hummock banks and very wet "mud-bottom" fen areas called "flarks". Muddus is non-calcareous, though not extremely so.

The last few days of the excursion will be spent in the mountains near Abisko. The interesting "pals" or peat-hillock mire type, characteristic of the tundras, is found E of Abisko, although in the subalpine birch-forest belt. For particulars about mire vegetation and other kinds of vegetation in this district, see publications by Prof. G. E. Du Rietz. Prof. Du Rietz will act as our guide at Abisko.

Thus, the excursion will give a section of our North Swedish mire world. Of course, it can give only a very fragmentary picture. The North Swedish mires are numerous and often

extensive. Their topography and appearance are manyfold, and so are their plant communities. In many districts very little is still known about them, so little, in fact, that the author felt some qualms about making them the subject of a regional study.

Institute of Plant Ecology (Växtbiologiska institutionen), University of Upsala, December 1949.

Programme.

July 22.

By train from Stockholm to Krylbo through the lowland of E Sweden. This country, which was totally submerged in late-glacial and early post-glacial times, is not very rugged and lacks real hills and valleys. The mires are topogenous fens and domed mosses; most of the latter are small and entirely covered by low pine (*Pinus silvestris*) forest. From Krylbo the excursion will go by car to the Bredmossen, a mire complex situated just at the boundary between the lowland and the hilly country of Bergslagen (W and N Västmanland, S Dalarna, etc.). The greater part of the mire complex is taken up by a moss or bog, which is domed and built up in an almost (but not quite) regularly concentrical manner. Cf. Sjörs 1948 (p. 180 and Pl. 2), 1949 a, and 1950.

The marginal fen separating the moss from the mineral ground is called "lagg". It forms a narrow strip all around the central moss, but is very unequally developed, in part very narrow and dry, in part about 100 m wide, and rather wet. It is occupied by various sedge (*Carex lasiocarpa*, etc.) communities, mostly with *Sphagna* in the bottom layer, and for the greater part belonging to the "transitional poor fen" of Du Rietz. A list of the species in one section of it is given

in SJÖRS 1948 p. 181. Besides, examples of both the "extreme poor fen" and the "transitional rich fen" occur locally.

After crossing the lagg, one proceeds through the marginal *Pinus silvestris* zone of the moss. *Ledum palustre*, an eastern species, and *Betula nana*, a northern one, are prominent, together with e. g. *Vaccinium uliginosum*, *V. Vitis-idaea*, *V. Myrtillus*, *Calluna vulgaris*, *Empetrum nigrum*, *Andromeda Polifolia*, *Eriophorum vaginatum*, *Rubus Chamaemorus*. The marginal pine forest is about 100 m wide (in part narrower) and has a rise of about 2 m.

The open central area of the moss is occupied by hummocks and hollows. The hummocks are mainly built up by *Sphagnum fuscum*, the most important constituent of the *Calluna - Cladonia - Sphagnum fuscum* association of the northern and eastern moss (bog) hummocks. The hollows are more differentiated. The shallow depressions are occupied by the *Eriophorum vaginatum - Sphagnum balticum - cuspidatum* association, *S. cuspidatum* growing in wetter places than *S. balticum*. *S. rubellum* usually forms a narrow transition belt between *S. balticum* in the hollows and *S. fuscum* on the hummocks. The western and northern *Scirpus caespitosus* occurs only sparsely, growing together with *Eriophorum vaginatum*. The deep depressions are occupied by the *Scheuchzeria - Rhynchospora alba - Carex limosa - Sphagnum cuspidatum* association also containing *Eriophorum vaginatum*, *Drosera anglica*, etc. "Mud-bottom" communities also occur, but only in small patches. The hollows, esp. the deeper ones, are elongated, at right angles to the slope, and consequently form a concentric pattern, very clearly visible in air pictures (SJÖRS 1948 Pl. 2). The species found in the central open area are listed in SJÖRS 1948 p. 183.

The moss vegetation of the Bredmossen is intermediate

between that of the mosses of the E Swedish plain (e. g. the Ryggmossen in Uppland, visited by excursion A II b) and that of such upland mosses as are situated within the Skattlösbergs Stormosse complex (p. 14). As to hydrotopography, the Bredmossen, with its domed central moss, is still a good representative of the former type of mire complex, although there are some irregularities suggestive of the latter type.

From the Bredmossen, we shall return to the valley of the river Dalälven. After crossing the river at Avesta, the road follows an esker parallel to the river. On the sides of the esker, there are rows of depressions (esker-pits), often longish in shape, and occupied by small, but deep, lakes or mires. One of the latter will be visited at Rutbo. It gives an excellent instance of fen "carpet" vegetation nearly as poor in macroscopic species as moss (bog) hollow vegetation. Most of the vegetation in the longish depression is dominated by *Eriophorum vaginatum* (drier places) and *Scheuchzeria palustris*, *Rhynchospora alba* or *Carex limosa* (wetter places). Other common plants are *Andromeda Polifolia* and *Drosera anglica*. Over large areas not a single plant of the field layer indicates that this is fen, not moss hollow vegetation, but in the bottom layer, the "poor fen" plant *Sphagnum apiculatum* is abundant, together with *S. Dusenii* (a moss hollow plant only in the uplands), and in somewhat drier places *S. balticum*, *S. rubellum*, and *S. magellanicum*. *S. fuscum* occurs only in small patches, and *Calluna* is absent. — At the edge of the mire, *Carex globularis* occurs abundantly in a very typical habitat. This northern, acidiphilous plant thrives in the belt of transition between heath forest and oligotrophic mire.

Another small esker-pit mire will possibly be visited at Västerby. There is more variety about this one. In part it is developed as moss (both open and pine-clad). The lagg is rudimen-

tary (*Carex fusca, C. magellanica, Eriophorum angustifolium, Menyanthes trifoliata* etc. present), rather dry and with trees, mainly spruce (*Picea Abies*). The marginal pine forest forms only a narrow zone, which is the highest part of the moss, as the central open area has developed as a very shallow depression, with *Eriophorum vaginatum* and *Sphagnum fuscum* as chief dominants. In a small, very wet area in the centre there is a "poor fen" very similar to that of the esker-pit mire at Rutbo, (except that *Sphagnum cuspidatum* and *S. Lindbergii*, a northern species, are present, and *Carex limosa* is absent). The cause of this aberrant zonation is evidently the great depth of the esker-pit, its central part not yet being quite filled up, so that the peat is still loose and quaking and cannot support moss (bog) hummocks. — The other parts of the mire are composed of pine-clad moss (with *Betula nana*), of open moss, and of fen not always so extremely poor in species as that mentioned above. Two small but deep tarns (with *Nuphar luteum*) are remainders of the lake that once filled the whole depression, which consists of several connected esker-pits, in part separated by a low side-esker.

The change in flora along the route of the excursion is striking. The southern coniferous (*Pinus silvestris* and *Picea Abies*) forest region with groves of oaks (*Quercus Robur*, in the S and SW also *Q. petraea*), and with many other southern plants, is restricted, in E Sweden, to the lowland. At the border of the hilly country, the "*limes norrlandicus*" of Sernander (cf. M. Fries 1948), it is replaced by the northern coniferous forest region. In this region, in which the conifers mentioned are still more predominating, the wild oak and many other southern species are wanting, others occurring only as rare plants in its S and SE parts. The "*limes norrlandicus*" goes from southern Värmland via the Kilsbergen hills of Närke

towards the NE across Västmanland and the SE corner of Dalarna, onward to the coast. We crossed it somewhere in the neighbourhood of Krylbo. The north-westernmost wild oaks grow E of Krylbo, at some distance from our route. The hazel (*Corylus Avellana*) is rare NW of the "*limes*". It occurs among several other southern plants on the SE precipice of the hill Bispbergs klack that can be seen near by just before we arrive at the town of Säter. Another rich locality for southern plants will be visited next day. Northern plants already met with are *Betula nana* (Bredmossen, Västerby). *Carex globularis* (Rutbo), *Sphagnum Lindbergii* (Västerby), *Cetraria Delisei* (Bredmossen), and the very common *Alnus incana*.

July 23.

From Lake Ljustern at Säter, a small stream runs through the thick silt deposits forming a plain between Säter and the river Dalälven. The stream has dug out a canyon-like, 40—50 m deep valley with very steep sides. On both sides of the ravine solifluxion and rain-water erosion have cut down numerous side-valleys, so that the system of ravines branches out like a tree. We shall visit its central part, the Norddalen.

The sides of the valleys are mostly covered by *Alnus incana* forest with *Prunus Padus* and *Sorbus Aucuparia* as the most common subdominants. In other parts the forest is composed of several co-dominating deciduous trees, besides those mentioned, and a few others, also *Ulmus glabra*, in the main a southern species. Sometimes the deciduous trees are replaced by the spruce (*Picea Abies*), which, on the other hand, may be entirely absent over large stretches of the valley-sides. Probably the unstable soil is unfavourable to the spruce, which would otherwise gain over the other trees in the long run. Cattle usually

graze in these forests, if the slopes are not too steep. *Alnus incana*, which is a northern species in Sweden, is much favoured by the grazing, as its numerous root-shoots are not eaten by the cattle. Some of the deciduous forest stands may, however, be regarded as almost primeval, a very rare case in Sweden outside the mountains.

There are also open pastures and a few beautiful hay-meadows with scattered trees. Southern species are numerous in the meadows and meadow-groves (e. g. *Carex contigua*, *Primula veris*, *Crepis praemorsa*, *Impatiens Noli-tangere*, *Adoxa Moschatellina*). Many less pronouncedly southern species occur plentifully, besides the elm, such as *Ribes alpinum*, *Lonicera Xylosteum*, *Anemone Hepatica*, *A. nemorosa*, *Stachys silvatica*, *Viscaria vulgaris*, *Lathyrus vernus*, and *Convallaria majalis*. Many of the most luxuriant plants are widespread in N Sweden, e. g. *Ribes spicatum* coll., *Geranium silvaticum*, *Melandrium rubrum*, *Stellaria nemorum*, *Matteuccia Struthiopteris*. The ordinary heath forest species are rare or absent. - Cf. v. Post 1938, Samuelsson 1925 pp. 28—31, Sjörs 1949 b.

In case the weather is warm, the afternoon will be spent swimming in Lake Ljustern. As the bottom is sandy, the lake vegetation is scanty. It is intermediate between that of the poor lakes of the woodlands and the rich lakes of the sedimentary plains.

In the evening we shall go by train via Borlänge and Ludvika on Lake Väsman to Grangärde. From Borlänge on, most of the journey goes through hilly, moraine-covered woodlands, quite unlike the sediment-covered broad valley of the Dalälven.

July 24.

From Grangärde to Sunnansjö and then towards the W. As the country is gradually rising, we shall arrive in a

region of higher precipitation and humidity. At Skattlösberg, a small village situated on a hill at about 350 m altitude, some self-grown, never manured hay-meadows with deciduous trees (mostly birches) will be studied. Most meadows of this kind have in recent years been changed into arable land, pastures, or forests, but the meadows at Skattlösberg are still mowed in the old way. The meadows have a rich flora, which is distinctly different from that of the ravines at Säter. Most southern species are lacking (exceptions e.g. *Tilia cordata*, *Sieglingia decumbens*, *Linum catharticum*, all of them rare). Northern species are, for example, *Selaginella Selaginoides*, *Phleum commutatum*, *Carex vaginata*, *Luzula sudetica*, *Hylocomium pyrenaicum*. Other interesting species are *Gymnadenia conopsea*, *Listera ovata*, *Botrychium Lunaria*, *Carex capillaris*, *Briza media*. Some of these plants have been regarded as indicators of lime. However, the soil seems to be poor in lime here. The superficial stratum consists of mull and rests on podsoled mineral soil, the podsolization being strongest in comparatively dry places. — Cf. Sjörs 1949 b.

The rest of the day will be spent on the big mire complex Skattlösbergs Stormosse, monographed and mapped in Sjörs 1948. The two Folder Maps of this guide are taken from that work. The route, which can be followed on the larger Map, passes Lake Latalam, a mud-bottom lake with *Nymphaea alba* × *candida*, *Carex rostrata*, and *Equisetum fluviatile* in very poor water vegetation. A brook, the outflow of the greater part of the mire complex, runs into the W end of the small lake, feeding it with very humous, red-brown water. The brook is surrounded by a sloping, rather dry fen, rich in *Molinia coerulea* and also in *Scirpus caespitosus*. Such communities are here termed "lawns" (Sjörs 1948 pp. 62, 282; 1950). When typically developed, they are almost smooth and very

firm, giving a steady support to the foot. Very often, however, they are less lawn-like because of the surface being more or less tussocky, as some of the chief plants grow in tufts (e.g. *Scirpus caespitosus*, *Eriophorum vaginatum*, in "rich fens" sometimes *Schoenus ferrugineus*). *Molinia* is usually present in fen "lawns" except in those that are very poor in species and resemble the moss (bog) hollows. The *Eriophorum vaginatum - Scirpus caespitosus* vegetation in the latter may be looked upon as the "lawns" of the moss, or bog, group of the mire communities. "Lawns" are, in fens, mainly distributed in western and northern Fennoscandia, being favoured by the humid climate and by a sloping condition of the fen surface. This is especially true of the most typical fen "lawns", those dominated by *Molinia* and *Scirpus caespitosus* (a northern and western species., lacking or very rare in E Sweden).

The *Molinia* fen "lawn", which we are now going to visit, is fairly rich in species. In fact, it contains many of the species indicative of the "rich fen" as well as those regarded as indicative of the "poor fen". Such fens, intermediate between the two, through containing elements of both, are very widely distributed in N Fennoscandia, esp. in the non-calcareous districts, where they often are the richest type of mire vegetation that can be found. Their content of electrolytes is usually very low, but they are only weakly acid. pH is usually about 6; in the brook here pH was found to be 6.1 and $\varkappa_{20}$ (electrical conductance at +20° C) $16 \cdot 10^{-6}$, in a small depression near the brook pH was 4.9 and $\varkappa_{20}$ also $16 \cdot 10^{-6}$, after elimination of the conductance of hydrogen ions. — The vegetation has been analysed in Sjörs 1948 Table I nos. 18—25; outside the squares there occur at least the 15 species listed on the page following the Table. (Note. The arrow has been inserted at the wrong section of the text.) A small orange *Clavaria* (possibly a new

species) occurs abundantly on the peat banks of the brook, and these are locally crowned by tufts of a suboceanic bryophyte, *Sphagnum molle*, here near its N limit in Sweden. Other suboceanic *Sphagna* are *S. imbricatum*, *S. auriculatum*, and the more common *S. pulchrum*. In the brook there also occurs a suboceanic species, viz. *Potamogeton oblongus*, growing together with *Juncus bulbosus*, *Utricularia intermedia*, and *U. minor*.

The route proceeds upwards along the S side of the brook. As the slope is now very slight, the fen alongside the brook is badly drained, and its vegetation is much more hydrophilous, being mainly composed of "carpets" and "mud-bottom communities". These have a sparse field layer of sedges and the like, mostly low species such as *Carex limosa*, *C. chordorrhiza*, *C. livida* (northern), *Rhynchospora alba* (southern), and *Scheuchzeria palustris*. *Menyanthes trifoliata* is also common. Tall sedges (*C. lasiocarpa*, *C. rostrata*) or other tall species (e.g. *Equisetum fluviatile*, *Eriophorum angustifolium*, sometimes *Phragmites communis*) are often present, but grow comparatively sparsely, contrary to the conditions in the true "tall sedge" communities (*magnocariceta*). "Carpets" and "mud-bottoms" differ in the bottom layer. In the former various bryophytes form an almost unbroken bottom layer, often very thick, loose and soft. In the latter a few of the same bryophytes are usually present, but they are only represented by scattered, more or less loose-lying, horizontally growing specimens, often almost overgrown with luxuriant algae. As is evident, the floristic difference is very small between the two groups of plant communities whose physiognomical appearance is so dissimilar. There are a few species clearly preferring "mud-bottoms", most common of which are *Juncus stygius*, *Utricularia intermedia*, and the hepatic *Gymnocolea inflata*.

In the wet fen alongside the brook in the Skattlösbergs Stormosse (the Central Soak), "mud-bottoms" prevail, and "carpets" are only locally of any considerable extension. The mud-bottoms form very shallow basins, with open water only in the wet periods, and separated from each other by very low fen "lawn" or, sometimes, "carpet" banks. These basins, which are always extended at right angles to the slope, are examples of "flarks". Such features occur in great quantity in many of the northern fens (and mixed mires). They are very typically developed in the fen water tracks of this mire complex. Typical "flarks" have not been reported S of the "*limes norrlandicus*".

The flarks seen in the Central Soak are poor in species. A typical plant list is given in Sjörs 1948 p. 137; pH was 4.6, and the conductance, diminished with that of the hydrogen ions, was about $7 \cdot 10^{-6}$, showing that the water was very poor in electrolytes.

From the Central Soak, the route goes obliquely upwards across the slope of the adjacent moss ("Älgmossen"). This moss slopes unilaterally, and is thus eccentrically developed. Its most elevated part lies close to the mineral ground on the S side. The "lagg" there is fragmentary. On the slope, esp. in the lower parts, large elongated hollows extend at right angles to the slope, and the hummocks form damming banks between them. The hollows are taken up by "lawns", "carpets", and "mud-bottoms" of the moss or bog series of vegetation. Chief dominants: in the "lawns" *Eriophorum vaginatum*, *Scirpus caespitosus*, *Sphagnum balticum*, in the "carpets" *Carex limosa*, *Rhynchospora alba*, *Scheuchzeria palustris*, *Eriophorum vaginatum*, *Sphagnum cuspidatum*, *S. Dusenii*, in the "mud-bottoms" the same vascular plants as in the "carpets", and the violet alga *Zygogonium ericetorum*. pH

was found to be 3.7 both in a "lawn" and in a "mud-bottom" hollow.

The reason why such a slope is not irrigated with soligenous water is that the mineral ground above it consists of a sandy ablation moraine ridge of small extension. This ridge produces only a small amount of run-off water, and because of the good permeability of the soil, this water is delivered only at few points. From these, small "soaks", or soligenous water tracks surrounded by ombrogenous moss, proceed downwards. Our walk will take us across the westernmost of these. It is easily distinguished by the greener colour of its vegetation (the hummocks are less developed, making the flow of water easier). The chief difference between this soak vegetation and moss (bog) vegetation is the abundant presence of *Carex pauciflora* and *Sphagnum papillosum*. In this case the influence of the soak water is little, as is evident from the small difference in vegetation.

After crossing the marginal pine zone, which is well developed only in places, and lacks the eastern *Ledum*, we shall arrive at another, much stronger water track, developed in a branch of the Central Soak W of the Älgmossen. This water track is formed by a row of dense-lying flarks separated from each other by narrow strips of fen "lawn", and the whole vegetation is much richer than that of the Central Soak proper. We shall follow the water track upstream. The slope grows steeper, and there is a noticeable difference in level between the adjacent flarks in the row. At a terrace near a small mineral ground island a beautiful vegetation of *Eriophorum latifolium* occurs. *Molinia* and *Carex dioeca* are also prominent, as are *Campylium stellatum* and *Sphagnum plumulosum* in the bottom layer. Analyses of the vegetation are given in Sjörs 1948 Table K. Additional species are mentioned in the

text of the Table. Of the fens in the Skattlösbergs Stormosse this one is most advanced in the direction of "rich fen". The water has the highest pH (6.5—6.8) and conductance (58—$62 \cdot 10^{-6}$) found there, and a strong formation of iron ochre takes place. The other more or less "rich fens," within this mire complex, that have been investigated with respect to conductance have values of only about 20.10^{-6}, thus clearly to be classified as non-calcareous (about 2 mg Ca per l) and proving that "rich fens" can develop at quite low metal ion concentrations, just as low, in fact, as those of many "poor fens," provided that pH is not too low. Iron ochre is usually not formed when pH is lower than 5 (the solubility of ferric hydroxide is considerable at pH 4 or lower).

We shall proceed towards the W across sloping fens, no longer so rich in species, and with water tracks provided with "flarks". On the upper part of the slope patches of pine-clad moss (without hollows) are often situated between the water tracks, or soaks. Thus a sloping "soak network" is formed. This is a peculiar sort of "mixed mire" (mixture of moss and fen), characterized by the fact that the extension of the components is in the direction of the slope, not at right angles to it as in other cases.

The total rise from Lake Latalam to the highest elevation of the mire, a few hundred m S of the route of the excursion, is 15 m. The steepest local slope is 1: 10, in a well-watered soligenous fen near the margin.

We now reach the mineral ground, which consists of ablation moraine. After that we come to a low sandy esker. The esker forms a promontory surrounded by moss at "Trindmosskaris" on the Map. There is no "lagg", only a narrow strip of *Carex globularis* vegetation. The marginal pine forest of the moss is also rudimentary. The moss ("Trindmossen") is saddle-

shaped. On its slope towards the NE, water is forced to the surface by a threshold formed by the underlying mineral ground. This mineral soil water produces a fen vegetation that grows richer in species on the lower part of the slope (1: 30). A transect in SJÖRS 1948 p. 76. - After crossing the moss, we shall have covered a distance of 2 km across the whole mire complex. Then we shall strike a road, and go back to Grangärde.

July 25.

The same road as the preceding day will be followed. The first stop is at Källfallet, where we shall visit a small fen near the road. Here the soil is calcareous (the Archaean rock contains some calcareous minerals). The small central area of the fen is chiefly occupied by a *Schoenus ferrugineus* "rich fen lawn". (Vegetation analyses in SJÖRS 1948 Table L; the additional species are listed in the text of the Table.) The marginal fen vegetation is different (a list of the species in one section of it on pp. 147–148). Among the interesting species of this fen may be especially mentioned: *Tofieldia pusilla*, at its S limit of distribution, *Equisetum scirpoides* (also northern), *Scirpus pauciflorus*, *Epipactis Helleborine*, different types of *Orchis* of the *incarnata* group, the liverworts *Leiocolea Schultzii* and *Moerchia hibernica*, and the gasteromycete *Bovistella paludosa*. This vegetation is much richer floristically than any vegetation in the Skattlösbergs Stormosse. The reason is evidently the richness in lime (water analysis on p. 100 no. 16: pH 7.1, $\varkappa_{20}$ $111 \cdot 10^{-6}$, Ca 18 mg per l).

Then to the NW part of the Skattlösbergs Stormosse, where the rest of the day will be spent in the "Special Area." Hydrotopographical and ecological problems have been studied in

detail in this area. It is not possible to give an account of the work in this little guide. The two chapters (pp. 68—171) in SJÖRS 1948 dealing with the Skattlösbergs Stormosse (mainly the Special Area) have been summarized in English in that work (pp. 282—286). There are also several diagrams (pp. 82, 87, 88—89, 93, 97), tables of hydrochemical determinations (pp. 98, 100), and, at the end of the book, tables of vegetation analyses (most of them from the Special Area), 117 maps showing the distribution of certain habitat conditions and of most of the plant species in the Special Area, some plates (nos. 21—32), and two folder maps, one of the Special Area and one of the whole mire complex (the same two as in this guide). — The route of the day may be followed on the Map of the Special Area. The references below are to SJÖRS 1948.

We shall follow an esker for a short distance, until there is a gap in it, where some springs bring the water of the esker to the surface. This is the N Spring Area, where a rich, though not calciphilous, vegetation has developed (Table U). Among the bryophytes, *Scapania uliginosa* has here its southernmost station in Sweden, and other northern species are *S. hyperborea*, *Calliergon sarmentosum*, and *Drepanocladus purpurascens*.

S and SW of the springs there is a typical "lagg" with "poor fen" communities of the "mire margin" type (Table Q nos. 1—33), with *Salix aurita*, *Carex fusca*, *C. vaginata*, *Calamagrostis purpurea*, *Maianthemum bifolium*, and other species which are mostly lacking in "mire expanse" fen communities. The great importance of this "direction of variation" in the fen vegetation was one of the chief results of the cartographical floristic analysis of the Special Area (cf. Small Maps 66—98).

Outside the lagg there is some marginal moss (bog) forest

(Table A; without *Ledum*, which is a rarity in the mire), and then open sloping moss (Tables B—E), split by three soaks. The first, the *Scirpus caespitosus* Soak, has very acid water and very poor fen vegetation (Table F; *Carex pauciflora* is the chief fen species). The second, the *Carex lasiocarpa* Soak, has a good flow of clear water coming from springs (to be visited later). The vegetation will be mentioned below. The third soak is the *Carex rostrata* Soak. It is very acid and has "extreme poor fen" vegetation, though different from that of the *Scirpus* Soak in being "carpet", not "lawn" (Table M, in part).

The *rostrata* Soak runs into a fen near the S edge of the Map. Here there is also much "mud-bottom" vegetation in "flarks" in the water tracks, besides "carpets" and "lawns". Among the species of this variable vegetation (Tables I, nos. 1—10; M, in part; O, nos. 1—24) *Juncus stygius*, *Lycopodium inundatum*, and *Sphagnum pulchrum* may be mentioned. Iron ochre occurs in places, and a few "rich fen" species are present, e.g. *Scirpus Hudsonianus*. The water comes mainly from the W, from a fen that is about 1.5 m higher. This fen is situated on the other side of an ajacent small ablation moraine ridge, through which the water passes. The latter fen is also rich in iron ochre, but has a different vegetation, which belongs to the "mire margin" type (richer than that mentioned above; Table R).

The sources of the *lasiocarpa* Soak are situated 2 m higher, at the W margin of the mire next to the esker, and consist of two springs, with small crater-shaped openings embedded in a light green *Philonotis fontana* "carpet" (Table V). From there, the flow of water follows the mire margin forming a "lagg" with a narrow water track (not split up into flarks, because the flow is too strong). Although the water is non-

calcareous, the vegetation is rich in species in the track (Table N nos. 28—54). Even such typical "rich fen" bryophytes are present as *Calliergon Richardsonii*, *Scorpidium scorpioides*, *Drepanocladus intermedius*, and *Campylium stellatum*.

At a point where the mineral ground makes a small tongue, the flow of water leaves it and goes straight down the mire slope, forming the *lasiocarpa* Soak which we have crossed earlier on our walk. Its chief dominants are *Carex lasiocarpa* and *Calliergon sarmentosum*. The richness in species decreases gradually (Table N nos. 27—1, to be read backward if the soak is followed downstream), until, in one of the first "flarks," even *Carex lasiocarpa* ceases to appear. The water flows from one elongated basin to another, thus spreading over a wide sector and mixing with water from the surrounding moss. With the exception of *Carex pauciflora* and a few bryophytes, only very scattered fen plants (e.g. *Menyanthes*) are to be found in this area, which has the appearance of a moss but is still influenced by the soak (Table G). The longest basin (90 m) has open water, where *Sparganium angustifolium* grows.

A study of the variations in the water level during changing weather conditions was made in this part of the Special Area. Rules were derived for the behaviour of the water table in a sloping mire. Cf. pp. 38—42, 86—94, and 279, 283—284.

N of the large elongated hollows there is a large funnel-shaped depression at the mire edge, about 1.5 m deep (on the mire side). In the bottom of the funnel, a small brook disappears into a "swallow-hole." The brook comes from the N Spring Area that was our first goal this morning. It runs for the most part in tunnels in the peat but has also short open stretches, to which almost all the drop of the water level is concentrated. In the tunnels, the drop is only a few cm, and the velocity of the water only about 1 m per min. This is due

to the surprisingly large dimensions of the tunnels, the vertical and horizontal diameters being about 0.5 m and 1 m respectively, as found by digging. Oxidation, not erosion, is thought to be the cause of the widening of the overgrown stretches of the brook.

After returning to Grangärde, we shall continue by night train to Jämtland.

July 26.

At Åre we shall meet the mountains (Mts. Renfjället, Åreskutan, Mullfjället). Beautiful mountain sceneries (in good weather the Sylarna, 1 762 m) are visible across Lake Ånn. Only glimpses of the mire landscape between the railway and the lake can bee seen from the train. Stop at Enafors.

Walk to the hill Högåsen N of Enafors. A small moss mostly with mud-bottom hollows is situated just on the other side of the railway. At the foot of the hill, there is a gently sloping *Carex lasiocarpa* fen "carpet," that suddenly changes into a *Scirpus caespitosus - Molinia coerulea* fen "lawn", as the slope becomes stronger. Both types of fen are rather rich in species, among them *Saxifraga aizoides* and *Pedicularis Oederi*. The latter belongs to the southern distribution group of the mountain plants of Scandinavia, supposed to have survived the last glaciation in refugia in the south only. We shall follow the network of sloping fens upwards, on the side of the hill. Some types of forest vegetation are also to be studied. Western species in the forest are *Blechnum spicant*, *Polygonatum verticillatum*, and *Cornus suecica*, the latter very common. In somewhat irrigated places, the forest vegetation is of the meadow type with a field layer of tall herbs such as *Aconitum septentrionale*, *Lactuca alpina*, *Polygonatum verticillatum*, etc.

(cf. M. Fries 1949) esp. on the higher parts of the hillside, where the spruce is gradually replaced by the mountain birch (*Betula tortuosa*) as the dominant forest tree.

Suddenly the forest ends and the open summit plateau of the hill begins. Scattered low spruces (with a rare epiphytic lichen, *Tholurna dissimilis*, endemic in Fennoscandia, cf. Ahlner 1948) grow in small groups that are the result of vegetative reproduction. For the rest, the plateau is covered by treeless mire and heath vegetation, all peat-forming. On the wind-swept summit (725 m) the effects of the lack of snow shelter in winter can be observed in the composition of the vegetation as well as in the signs of frost action and wind erosion. — The mires at Enafors are to be described in a future paper. For sloping fens, cf. also Sjörs 1946 b.

July 27.

Weather permitting, ascent of Mt. Storsnasen (1 463 m; the highest summit among the Snasahögarna). We shall cross the river Enan by boat, and then walk across 4 km of spruce forest, partly replaced by more or less sloping, shallow mosses and, to a small extent, by interesting low wind-heath hillocks, with the mountain species *Juncus trifidus*, *Loiseleuria procumbens*, *Arctostaphylos alpina*, and *Carex Bigelowii*. On the banks of the stream Ingolvån, several other mountain plants are met with, e.g. *Oxyria digyna*, *Saxifraga aizoides*. At the foot of the mountain the subalpine birch forest begins at about 675 m above sea level. The forest is at first well-grown but soon becomes low and non-continuous on the steep lower parts of the mountain-side. The vegetation shows signs of long-lasting snow cover; note, for example, the occurrence of *Gnaphalium supinum* and other snow-bed plants, esp. in the gorge of the stream, which forms a series of waterfalls here, the

"Silverfallet". On a shelf on the wall of the gorge, and also on the steep wall opposite, fragments are found of calciphilous *Dryas* vegetation, with *Dryas octopetala*, *Carex rupestris*, *Coeloglossum viride*, *Bartsia alpina*, *Saxifraga aizoides*, *Erigeron uniflorus*, *Salix hastata*, *Thalictrum alpinum*, and many others.

The calciphilous component in the vegetation disappears in the low alpine region reached just above the falls, at about 850 m, where the slope is less steep. Most of the vegetation is made up by two plant communities, the *Empetrum hermaphroditum* heath occurring in wind-swept places with little or no snow and the *Vaccinium Myrtillus* heath covering the moderately snow-sheltered areas. These communities are both acidiphilous and poor in species. They are regarded as alliances (*Empetrion* and *Myrtillion*, Du Rietz 1942 a). The deeper pits with more long-lasting snow cover are occupied by the *Nardus stricta - Anthoxanthum odoratum - Deschampsia flexuosa* heath (*Deschampsio-Anthoxanthion* in Du Rietz), but as there is a very strong flow of soligenous water on this mountain-side, most small snow-pits are occupied by more hygrophilous communities, esp. the *Athyrium alpestre* community, various spring fen-meadow communities, and thickets of grey willows (*Salix lapponum*, *S. glauca*). These plant communities are better developed further down, in the upper subalpine belt, to the west of the path followed by the excursion. Big snow-beds occur there about 500 m further west. (Their vegetation, in which *Salix herbacea* plays a great part, belongs mainly to the alliance *Herbaceon* of Du Rietz. For acidiphilous snow-bed vegetation cf. also Gjærevoll 1949.)

After crossing the stream again, we shall reach the side of Mt. Storsnasen. The vegetation becomes gradually less continuous, solifluxion phenomena causing "streams of stones" to flow down the mountain-side. The *Vaccinium Myrtillus*

heath is restricted to places without solifluxion and with very favourable snow conditions, and at about 1 100 m it begins to disappear. The uppermost *Vaccinium Myrtillus* is found at about 1 130 m, where the middle alpine belt is said to begin. Like the other limits of plants and vegetation, this limit is situated at an unusually low altitude here, on the side of the mountain facing the north. Kilander has found *Vaccinium Myrtillus* at 1 221 m on the NW slope and at 1 335 m on the S slope. Cf. Kilander 1950.

Luzula arcuata and *Ranunculus glacialis* are conspicuous plants in the middle alpine vegetation. *Deschampsia alpina*, *Poa flexuosa* and *P. jemtlandica* (= *P. alpina* var. *vivipara* × *flexuosa*) may also be mentioned. Towards the summit, the vegetation becomes more scattered but is still middle alpine, as no high alpine region exists on this mountain. To the summit area (1 463 –1 457 m) have attained the following vascular plants: *Cardamine bellidifolia*, *Carex Bigelowii*, *Cassiope hypnoides*, *Diapensia lapponica*, *Empetrum hermaphroditum*, *Festuca vivipara*, *Gnaphalium supinum*, *Juncus trifidus*, *Loiseleuria procumbens*, *Luzula arcuata*, *Lycopodium Selago*, *Phyllodoce coerulea*, *Poa jemtlandica*, *Ranunculus glacialis*, *Salix herbacea*, *Sibbaldia procumbens*, *Silene acaulis*, *Trisetum spicatum*, and *Vaccinium Vitis-idaea* (according to notes kindly supplied by Fil. mag. S. Kilander).

July 28.

By train to Ånn and from there by boat to the mouth of the stream Härrån. The lake vegetation is to be demonstrated by Fil. lic. L. Faxén, who has given the following short notes.

Lake Ånn (Ånnsjön) is very shallow in its western and northern parts, being filled up by the sediments from the rivers Enan and Handölan, and more than a third of the lake is

usually bottom-frozen in winter. These parts have a very scanty vegetation of *Potamogeton perfoliatus*, *P. gramineus*, and *Sparganium* sp.

At the mouths of the streams and rivers the ice is thin, and sometimes there is no ice at all. Stream channels are formed below the ice, and here a rich vegetation is developed. In the channels, *Potamogeton rutilus*, a very rare species, *Myriophyllum spicatum* f. *squamosum*, *Hippuris vulgaris* f. *fluviatilis*, and *Potamogeton praelongus* are the main components and, between the channels, *Myriophyllum alterniflorum*, *Ranunculus peltatus*, and *Sparganium Friesii*. Large areas are entirely covered with the moss *Scorpidium scorpioides*.

The banks of the delta of the Härrån, which are more or less exposed during low water periods in summer, are covered with mats of *Scirpus acicularis* and *Ranunculus confervoides*, often with *Subularia aquatica*. Most of the delta-plains are overgrown with *Carex aquatilis* and fringed along the shore with a border of *Salix lapponum* or with extensive reeds of *Equisetum fluviatile*.

In the deeper parts of the areas that are bottom-frozen in winter, dense mats are formed on the bottom by *Isoëtes echinospora*. Outside these areas *I. lacustris* and *Myriophyllum alterniflorum* take up very great fields. In the more sandy parts of the not bottom-frozen areas *Lobelia Dortmanna* is a typical plant.

After landing, a moss situated on the peninsula of Halsen will be inspected.

July 29.

By train to Storlien. It will be observed that the hill Visjövalen (688 m) south of the railway is almost totally covered by mires, owing to its regularly domed shape and evenly slop-

ing sides. From Storlien a short walk to the summit of Mt. Skurdalshöjden, which consists of calcareous schists and carries a very rich vegetation. *Saxifraga Cotyledon* grows on vertical walls of schist. In the rich "tall herb" vegetation, *Ranunculus platanifolius* is present (distribution mapped in M. Fries 1949). The sloping fens and wet meadows are very rich in species, e.g. *Carex microglochin, C. atrofusca, C. saxatilis, Astragalus oroboides, Saxifraga aizoides, Juncus castaneus, Pedicularis Oederi, Kobresia simpliciuscula.* The latter two are southern mountain plants. However, a single station of *Kobresia simpliciuscula* has recently been found far north of its continuous area by Rune (1949). *Narthecium ossifragum* grows in patches in some sloping fens. Contrary to those enumerated above this is a non-calciphilous, western species occurring only in the highly humid mountains near the Norwegian boundary. Storlien, situated in a valley bottom at about 600 m, has slightly less than 1 m precipitation, and considerably more may be estimated for the higher slopes. The soligenous flow of water is very generous on Mt. Skurdalshöjden, causing numerous steeply sloping fens to appear on the lower parts of the slope. They are mostly replaced by wet meadows in the uppermost subalpine belt and the low alpine belt. The subalpine birch forest is well developed on the lower slopes but gradually splits into scattered groups of shrubs when approaching the low alpine belt. This begins at about 800 m and has only a small extension on this mountain.

The summit (839 m) consists of almost bare rock. *Saxifraga Cotyledon* occurs here in small crevices, together with a rather fragmentary *Dryas* heath of the type developing in windswept, almost snow-free localities. Among the other species are *Carex rupestris, Draba norvegica, Antennaria alpina, Chamorchis alpina, Silene acaulis, Salix reticulata, Saxifraga op-*

positifolia etc. — Note. All the plants near the summit, and all the occurrences of *Saxifraga Cotyledon* are protected. The participants in the excursion are requested not to collect too many specimens of other rare plants.

In the evening, by train to Hammerdal.

July 30.

By car to Fyrås in the parish of Hammerdal. The rocks are Cambro-Silurian, and the soil is very calcareous. Along our path there is an old disused dry hay-meadow where 3 species of *Botrychium* grow together, viz. *B. Lunaria*, *B. lanceolatum*, and *B. multifidum*. Then comes a large spring fen area, covered with a vegetation with *Equisetum palustre* and *Cratoneurum falcatum* as the chief dominants, and with interesting northern species: *Petasites frigidus*, *Epilobium Hornemanni*, *Equisetum scirpoides*, *Saussurea alpina*. This area is the source of a brook, the Blekmyrbäcken, the course of which we shall follow downstream. All along the brook, there are numerous springs, and a rich calciphilous vegetation. Additional species are, for example, *Orchis cruenta*, *Cystopteris fragilis*, *C. montana*, *Polygala Amarella*, *Tofieldia pusilla*, *Pinguicula vulgaris*, *Carex dioeca*, *C. capillaris*, *Eriophorum latifolium*, *Scirpus pauciflorus*, *Triglochin palustre*, and many calcicolous bryophytes, e.g. *Catoscopium nigritum*.

On the rather steep N side, at a point where the valley of the brook narrows, there are a few strong springs with small, but steep, brinks of calcareous tufa. The porous tufa is formed through calcium carbonate incrustation of the bottom layer, which consists of *Cratoneurum falcatum* and *C. decipiens*, the former species growing where the outflow of water is strongest. *Stellaria nemorum*, *Myosotis silvatica*, *Epilobium Hornemanni*, and *Petasites frigidus* are prominent species. The temperature

of the water was found to be +4°, pH was 7.8 and the conductance $314 \cdot 10^{-6}$. Further downstream, in the bottom of the valley, there are springs whose waters flow even more strongly. They are surrounded by *Salix* shrubs (*S. glauca*, *S. nigricans* etc.) and have a sparse field layer made up by a *Poa* of the collective *pratensis* group, and *Equisetum palustre*. In the ankle-deep, streaming water there grow large carpets of *Calliergon giganteum* and *Cratoneurum falcatum*. *C. filicinum*, *Philonotis calcarea*, and *Leiocolea bantryensis* are found, too. — All along the valley, more or less calcareous deposits occur in those places where outflowing water reaches the surface.

Less wet, sloping fen "lawns" are also common in the valley. They have a rich flora containing many species more or less favoured by the lime, e.g. *Eriophorum latifolium*, *Pedicularis Sceptrum-Carolinum*, *Ophrys insectifera*, *Gymnadenia conopsea*, *Listera ovata*, *Orchis cruenta*, *Thalictrum alpinum*, *Carex flava*, *Equisetum variegatum*, *Polygala Amarella*. — Time permitting, we shall visit a rich occurrence of *Cypripedium Calceolus* and some more lawns with *Ophrys* and *Carex capitata*.

The edge of the Silurian deposits forms an escarpment between the village of Fyrås and Lake Fyrsjön. Here, too, water comes forth through numerous springs and other, more diffuse, outlets, keeping the escarpment very wet, and thus providing excellent conditions for a "tall herb" vegetation, that consists mainly of *Aconitum septentrionale* and *Filipendula Ulmaria*, in the shade of which *Stellaria nemorum* is constantly found. Other species are *Melandrium rubrum*, *Ranunculus acris*, *Urtica dioeca*, *Crepis paludosa*, *Carex pallescens*, *Listera ovata*, *Tussilago Farfara*, etc. In drier and more sunny meadows some southern species occur, e.g. *Briza media*, *Avena pubescens*, *Vicia silvatica*, *Hypochoeris maculata*, and *Sesleria coerulea*

(the latter only sparsely and in a place not to be visited by us), and also the northern *Phleum commutatum* and *Poa alpina*. Northern species, however, are mostly found on the cold spring soil, e.g. *Carex atrata*, *Bartsia alpina*, *Juncus triglumis*, *Epilobium Hornemanni*, *Equisetum scirpoides*, *Saussurea alpina*. A limited formation of calcareous tufa takes place in this locality, too. The vegetation on the tufa is mainly dominated by *Carex vaginata* but also contains *C. capillaris*, *Scirpus pauciflorus*, *Juncus triglumis*, *J. alpinus* ssp. *nodulosus*, etc. The bottom layer consists chiefly of tufts of *Drepanocladus intermedius* and *Cratoneurum falcatum* besides bare spots white with calcium carbonate. In the water of a small pit pH was found to be 8.2 and $\varkappa_{20}$ $299 \cdot 10^{-6}$.

No less than four species of the moss genus *Cratoneurum* are found in the calcareous springs to be visited this day, viz. *C. falcatum*, *C. decipiens*, *C. commutatum*, and *C. filicinum*. It seems convenient to refer to this kind of spring vegetation as the *Cratoneurum* community. Esp. in the bottom layer, it is very different from the vegetation of non-calcareous springs (e.g. those on the Skattlösbergs Stormosse, and in Muddus), although both kinds are rich in species.

July 31.

By car to Ollsta in the parish of Häggenås. We shall follow a path that leads to the mire reserve "Storflon," within the State Forest "Österåsens Kronopark." *Carex microglochin* grows in a small fen crossed by the path. After a short walk through spruce forest, we shall reach the big mire expanse of Storflon. It is situated on the Cambro-Silurian plain, in a very shallow, irregular depression with many small moraine islands and a few small tarns. The mire is mostly "rich fen" with several species typical of the many large calcareous fens

on the flat Cambro-Silurian of Central Jämtland; *Schoenus ferrugineus*, *Carex heleonastes*, *C. diandra*, and *C. jemtlandica* (a near relative of *C. lepidocarpa*) may be mentioned. The latter species and its hybrid with *C. flava* are found before we arrive at the boundary of the State Forest. The Reserve begins at the same boundary and reaches as far as a nice water-lily tarn about 700 m further W. The vegetation of the Reserve is to be described in a paper by Du Rietz. Short notes have been given by him (1933; 1949 pp. 295, 298) and by Witting (1949 pp. 723—727, 737, Pl. I, II; in connexion with pH, conductance, and Ca determinations). The vegetation is composed of various fen communities, sometimes with low *Sphagnum fuscum* hummocks resembling moss (bog) hummocks but usually with a few fen plants. The fen vegetation covers the range from "extreme rich" calcareous fen to "extreme poor" non-calcareous fen. — Note. Collecting should be avoided within the Reserve.

From the water-lily tarn southward over "rich fen" expanses. "Mire margin" fen communities will also be studied (with *Carex loliacea*, *C. canescens*, *Listera cordata*, *Sphagnum Wulfianum*). Further south, *Schoenus ferrugineus* "lawns" are found, with *Carex jemtlandica*. The fen water is very calcareous here (pH 8.4, conductance $131 \cdot 10^{-6}$). *Myrica Gale*, which near its upper limit of distribution follows the water-courses, is abundant near Lake Öjsjön, an extremely shallow lake almost filled by calcareous algal mud. Its pH is extraordinarily high (9.0); conductance $131 \cdot 10^{-6}$. On the way along the lake back to the road, *Carex Buxbaumii*, *C. capitata*, *Salix myrsinites*, *Juncus triglumis*, and new rich occurrences of *Schoenus* are found. Cf. Asplund & Malmström 1925 pp. 8—9. — The excursion will continue to Östersund, and from there by night train to Lappland.

August 1.

From Nattavara by car to Urtemjaure and then on foot to Muddus National Park.

Muddus was made a National Park only 8 years ago. It was chosen as a reserve because it contains the only large continuous primeval coniferous forest area still remaining in Sweden, and is thus a rest of the old North Swedish forest wilderness which, elsewhere, has been almost entirely exploited. It serves as a refuge also for the fauna (e.g. *Ursus arctos*, *Cygnus cygnus*). Plant collecting is not allowed within the Reserve.

The National Park is about 500 square km in area, of which about 200 are mires and about 300 are forest. Of course, such a large area could not have escaped the axe, had it not been situated far from waterways for timber-floating, roads, and human dwellings. Even nowadays, access to the mire-covered interior is not easy (except from the air). The way from the E has been chosen for this excursion as it involves only a walk through easily penetrable country. One gets an idea of the desolateness of the landscape through the view we shall have next day from the hill Tjårreshuornats, and through the walk over the vast expanses of the mire Muddusluobbalape on August 3.

The path from Urtemjaure passes Lake Solaure and then some gently sloping fens, mostly made up by *Molinia* "lawns" rather rich in species, although non-calcareous like all mires of Muddus and its vicinity. Then along a boundary-clearing, which crosses the boundary of the National Park on the slope of the hill Linavare. Then we shall follow another path along a brook on the bottom of a shallow valley. This valley is filled up with glaciofluvial deposits bearing pine forest, the same glaciofluvial system as passes the hut Mansare and whose continuation to the NW is the esker Rovasenkielas. On these

deposits there are numerous springs; they appear only when the surrounding country is hilly. (No springs at all occur in the flat Central Muddus.) After crossing a side-valley we shall reach the Mansare hut, where a camp will be arranged. — The mires of Muddus have not yet been described, although much field work has been done by the author. A short preliminary paper in Swedish is Sjörs 1946 a; additional information in Sjörs 1950. A complete bibliography concerning the Muddus National Park was given by Florin 1948 pp. 20—21.

August 2.

The primeval pine forest on the glaciofluvial deposits at Mansare is tall and well-growing for this high latitude (N 67°). Cf. Arnborg's guide to Excursion C III d.

On irrigated peat soil in the side-valley E of Mansare there is a dense willow scrub about 3 m high (*Salix phylicifolia* coll.; in the outskirts *S. glauca* and *S. lapponum*). The undergrowth is sparse, due to the shade cast by the willows and the litter formed from their leaves. Moreover, there is little space for soil vegetation between the stem-bases and roots in the willow thicket. *Calamagrostis purpurea*, *Potentilla palustris*, *Equisetum arvense*, *Carex canescens*, *C. rostrata*, *Epilobium palustre*, *Parnassia palustris*, and *Viola epipsila* have been noted from the field layer, and *Sphagnum riparium*, *S. teres*, *Helodium Blandowii*, *Mnium cinclidioides*, *Calliergon cordifolium*, *C. stramineum*, *Scapania hyperborea*, and *Drepanocladus uncinatus* from the bottom layer; the last species is mainly epixylous.

The willow scrub is irrigated by the water of a spring brook running in part under the peat of the adjacent mire. If we follow the water-course upstream, we shall reach a beautiful spring area. The following species are most prominent in the spring vegetation: shrub layer: *Salix phylicifolia* coll.; field

layer: *Calamagrostis purpurea*, *Equisetum palustre*, *Carex canescens*, *Potentilla palustris*, *Epilobium Hornemanni*, *E. palustre*, *Stellaria calycantha*, *Poa pratensis* coll.; bottom layer: *Webera* (*Mniobryum*) *albicans* v. *glacialis*, *Bryum Duvalii*, *Philonotis seriata*, *Drepanocladus purpurascens*, *Mnium cinclidioides*. Especially the *Webera* species is suggestive of subalpine—alpine springs. It has not been found in other springs in Muddus. pH values that are unusually high for the water of Muddus have been measured, viz. 6.9 and 7.1.

The mire adjacent to the spring system is sloping, and for the most part it has the character of a *Carex* fen. *C. lasiocarpa* and *C. rostrata* are the field layer dominants (in different parts of the mire); other species are, for example, *C. pauciflora*, *Eriophorum vaginatum*, *Andromeda Polifolia*, *Betula nana*, *Equisetum fluviatile*. In the bottom layer, *Sphagnum riparium*, *S. Lindbergii*, and *Calliergon stramineum* are the chief dominants. In spite of the typical "poor fen" field layer, some more pretentious bryophytes occur in the best irrigated parts of the fen, viz. *Sphagnum teres*, *S. subfulvum*, *Calliergon sarmentosum*, *Drepanocladus purpurascens*, and *Paludella squarrosa*.

Other parts of the mire are very moss- (or bog-) like but contain *Equisetum silvaticum* and *Carex pauciflora* even in the hummock communities. In the depressions, some additional fen plants, such as *C. rostrata*, *C. canescens*, and *C. magellanica*, are to be found. In places where the soligenous flow of water is very faint, the vegetation of the mire margin is similar, but with trees. There may also be *Carex globularis* vegetation in such places. In the irrigated sections of the margin, the flora is richer. *Calamagrostis purpurea* and the willows are typical species.

On the slopes of the hill Tjårreshuornats (to the NNE), the influence of soligenous water is restricted to vertically extended

willow-clad furrows, the sources of the water-tracks on the sloping mires below. The network of sloping mires on the lower slopes of the hills, and in the valleys between them, is characteristic of the hilly country around the central Muddus plain, which has entirely different mire complexes.

Between the water tracks the slope of the Tjårreshuornats is covered with primeval spruce forest, in part mixed with pine. The forest grows well, considering the high latitude. Cf. ARNBORG's guide.

On the summit, the pine is predominant, and of less good growth. NW of the summit, the archaean, siliceous rock lies bare. These shelves give a good view over Muddus. The lonely, almost flat moraine landscape of Central Muddus consists of very low ridges and shallow depressions, both stretching in the direction NW—SE. The ridges are covered by poorly growing primeval spruce forest, the depressions by mires and, to a smaller extent, by shallow lakes, occupying their deepest parts. The largest lake, the Muddusjaure, and a smaller two-lobed one, the Muddusluobbal, are seen in the S. NE of these lies the big mire Muddusluobbalape, to be visited next day. – · Back to Mansare.

August 3.

From Mansare along the W slope of the hill Tjårreshuornats and then across the SE part of the mire Muddusluobbalape. From the sloping fens near the foot of the hill, the route proceeds over part of the wide central expanse of the mire; its 10 km length makes it one of the biggest in Muddus. The central expanse slopes only very gently and represents a type of mire complex quite different from that of the hilly country. This is the *aapa* complex of CAJANDER (1913) and his followers in Finland, a type of mire complex widely distributed in the

vast, badly drained plains and low plateaux of continental N Fennoscandia. *Aapa* is a Finnish word meaning a very large mire (the ending *-ape* is the Lappish equivalent). As a scientific term it has been used in a somewhat varying sense, sometimes including also the other kinds of northern mire complex, again, sometimes, restricted to the parts developed as "mixed mire," i.e. as a mixture of moss (bog) hummock banks, and wet fen. In CAJANDER, however, the *aapas* are whole mire complexes, to a great extent occupied by wet fens without such hummock banks, besides the "mixed mire" parts.

The walk over the Muddusluobbalape will give good instances of these two main components of the *aapa*, even if only a small part of the mire can be crossed. The interior of such a mire is accessible only with difficulty in a wet summer. Only if the summer should happen to be dry, it is advisable to proceed into the central parts. Especially crossing the mire brooks may be difficult if they carry much water. Thus, the exact route of the excursion cannot be given beforehand. Wherever they have developed, the long hummock banks are at right angles to the slope. It is necessary to walk in a direction that is parallel to them, as it is often impossible to cross the wet flarks between them. The hummock banks are mostly two or three feet high, a few m broad but often hundreds of m in length. The distance between them is dependent on the gradient and the water content of the mire. Thus they are ordinarily less widely separated in the proximal, more sloping and less wet parts of the complex than in the distal (lower), less sloping and more watery parts. This tendency leads to opening the network of moss hummock banks entirely in the lowest parts, esp. along the brooks, where large areas of pure fen have formed. These central fen areas of the *aapas* are often so slightly sloping that they could almost be regarded as topogenous. Some-

times (not in this mire) they are replaced by small shallow lakes. There are also other kinds of pure fen areas, of which those sloping more than the moss hummock bank complexes are important. They have developed where more soligenous water than usual has to take its way, and remind us of the sloping fens in the more rugged country, being composed by flarks and damming fen banks (usually with *Molinia* and *Carex lasiocarpa*), both of comparatively small dimensions.

The vegetation of these big mire expanses is not so monotonous as one is apt to believe. Various sedges (*Carex limosa*, *C. chordorrhiza*, *C. livida*, *C. rostrata*, *C. lasiocarpa* most important) alternate as chief dominants in the flarks, often over very large patches, but sometimes they are replaced by woolly *Eriophora*, such as the white *E. angustifolium* and *E. gracile* or the weakly rustcoloured *E. medium*. The latter is almost a "characteristic species," northern continental in distribution. *Scheuchzeria*, *Menyanthes*, and *Equisetum fluviatile* are other common species, sometimes dominating. *Scirpus caespitosus* is always present at the edges of the flarks, and sometimes it also forms secondary very low banks inside them. The pure fen areas have a similar, although less sparse vegetation. The tall sedges, *Carex rostrata* and *C. lasiocarpa*, dominate more frequently in these.

The flarks may be "poor fen" or "rich fen," or belong to an intermediate type, although the differences in the field layer are often insignificant, or none, and the more distinctive bryophyte vegetation may be completely lacking over large areas. Already in the transitions between poor and rich fen, *Juncus stygius* and *Utricularia intermedia* are sometimes found, and among the bryophytes *Calliergon sarmentosum* and *Drepanocladus procerus*. In the typical rich fens *Scorpidium scorpioides* is the chief bryophyte of the wet flarks, and other rich

fen bryophytes are frequent at the edges of them. Rich fen vascular plants (*Triglochin palustre*, *Carex heleonastes*, etc.) occur but rarely in the flarks. Several others (e.g. *Saussurea alpina*, *Pinguicula vulgaris*, *Tofieldia pusilla*, *Scirpus Hudsonianus*) occur along the edges. Clearly classifiable "rich fens" and "poor fens" are, on the whole, less widespread in Muddus than the more or less intermediate fens.

The moss (bog) hummock banks are dominated in the field layer by various dwarf-shrubs, among which *Betula nana* is by far the most prominent one. The peat is largely formed by *Sphagnum fuscum*, which, however, takes up but a moderate fraction of the surface, mostly being overgrown by lichens (many species of *Cladonia*, *Icmadophila ericetorum*, etc.), by heath mosses (*Pleurozium Schreberi*, *Dicranum Bergeri*, etc.), by hepatics (e.g. *Mylia anomala*), or simply by the dense dwarf-shrubs themselves. The banks are more or less raised through frost action during the hard winter, as the snow cover is considerably thinner above them than between them. Cf. Auer 1920.

After crossing the mire, we shall follow an esker back to Mansare. This esker, the Rovasenkielas, is very dry and covered with pine forest, with lichens in the bottom layer. Cf. Arnborg's guide.

August 4.

Back again to Urtemjaure. Opportunities for collecting plants, when the boundary of the National Park has been crossed. By car back to Nattavara, and from there by train to Abisko. Several large mires with flarks and moss hummock banks are visible from the train. Further north the coniferous trees begin to disappear. The last spruces will be observed soon after we have passed Kiruna. Fragments of pine forest

are present as far as the railway station Rautas. Then the pine is absent because of too high altitude around the stations Rensjön and Bergfors. It reappears just before the station Torneträsk and ceases definitely just W of next station, Stenbacken. However, an isolated pine population occurs further W, in the Abisko valley (Aug. 6). All the way from Kiruna, the mountain birch (*Betula tortuosa*) dominates the forest, which is considered as subalpine. — The valley of Lake Torne Träsk forms a monumental entrance into the mountain world.

August 5.

(By G. Einar Du Rietz).

By train to Låktajokk. Ascent along the eastern side of the valley Låktavagge: birch forest limit, *Salix* scrub, subalpine and low alpine meadows, low alpine heath, mostly of the poor acidiphilous (siliceous) type, differentiated by the snow conditions into a series of alliances (*Empetrion*, *Myrtillion*, *Deschampsio-Anthoxanthion*, *Salicion herbaceae*). Upper limit of the low alpine belt (*Vaccinium Myrtillus* limit) at 1070 m. Ascent through the middle alpine belt to the Låktatjåkko hut (1228 m). Lunch. Ascent through the upper part of the middle alpine belt and the lower part of the high alpine belt to the summit of Mt. Låktatjåkko (1 412 m). Descent towards the East through high alpine and middle alpine vegetation (the latter with fine *Cassiope tetragona* heath) to the longitude of Kopparåsen railway station, then over large steep snow fields down into the upper low alpine belt above Kopparåsen. The non-calcareous or slightly calcareous mica schists of the western and upper parts of Mt. Låktatjåkko are here replaced by calcareous schists, and the steep descent through the low alpine belt to Kopparåsen railway station will be made through

very rich calcareous heaths (various types of *Dryadion* heath and, in late-snow areas, *Salix reticulata* heath, *Salix polaris* heath) and meadows. In the upper part of this calcareous slope a small calcareous lake (the "*Scorpidium turgescens* lake," comp. Albertson 1940 p. 12 and Witting 1949 p. 735) will be passed. In the lowest part of the slope dense *Salix* scrub, *Trollius* meadow, and *Betula tortuosa* forest. Just above Kopparåsen station, the calcareous schists are replaced by siliceous rocks with the ordinary poor types of *Betula* forest, but there are also strong calcareous springs producing very rich fen areas (vegetation analyses as well as pH, $\varkappa$ and Ca determinations in Witting 1949 pp. 729, 733—734). As to the vegetation belts and the major plant communities of the calcareous and siliceous parts of Mt. Låktatjåkko comp. Du Rietz 1942 a and b, 1950. As to the vegetation of the late-snow areas ("snow beds") see Gjærevoll 1950.

August 6.

Mires, lakes, subalpine birch forests with a few pine stands, solifluxion heaths, etc., calcareous and non-calcareous, in the Abisko valley. Cf. Du Rietz 1950, and also Th. C. E. Fries 1919, Du Rietz 1921 a, 1921 b p. 161, 1942 a and b, Santesson 1937, Sandberg 1940 p. 74, Witting 1949 pp. 730 733. A complete bibliography concerning the Abisko National Park in Florin 1948 pp. 7—11.

August 7.

The morning may profitably be spent in packing etc. In the afternoon, by train eastward to Torneträsk railway station. A "pals" mire will be visited. The palses are huge hillocks of peat, which are perpetually frozen in the interior. The upper part is formed by moss (bog) hummock peat, the lower part

by fen peat pressed in from the sides during the freezing of the surrounding fen. Only the uppermost layer melts in summer. It may get very dry and has a wind-hard, dryness-standing vegetation of dwarf-shrubs and lichens. Wind erosion takes place very frequently and may ultimately break down the whole pals. In Sweden palses may reach a maximal height of 7 m (those visited are lower). They are distributed in our northernmost, mainly subalpine, districts, and from there eastward over N Finland, the Kola Peninsula, and the N Russian tundras. They need a winter climate with little snow, strong winds, and very low temperatures for their formation. Cf. Th. C. E. Fries & Bergström 1910, Th. C. E. Fries 1913 pp. 189—201, Du Rietz 1921 a pp. 11—13, 1921 b pp. 160—162, 1950, Lundqvist 1943 pp. 147—150, 1948 pp. 406—413.

The excursion ends here.

Participants who wish to go south immediately have to take a local train in the afternoon to Kiruna and proceed by night train to Stockholm. It is also possible to return to Abisko. From there an additional excursion to Björkliden (see Du Rietz 1950) may be arranged next day if a sufficient number of persons will take part in it.

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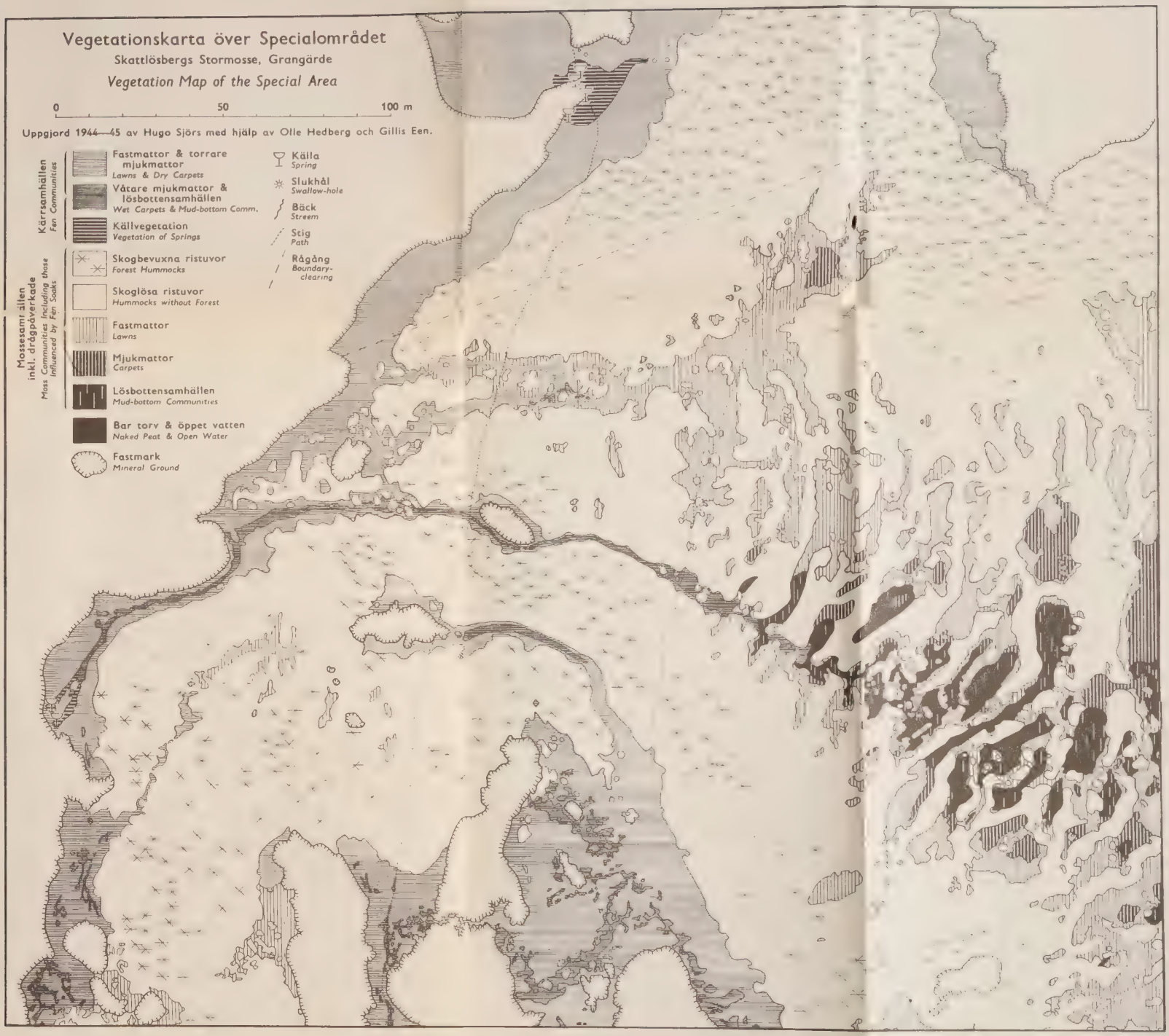
Vegetationskarta över Specialområdet
Skattlösbergs Stormosse, Grangärde
Vegetation Map of the Special Area
0
50
100 m
Uppgjord 1944—45 av Hugo Sjörs med hjälp av Olle Hedberg och Gillis Een.
Kärrsamhällen
Fen Communities
Fastmattor & torrare mjukmattor
Lawns & Dry Carpets
Våtare mjukmattor & lösbottensamhällen
Wet Carpets & Mud-bottom Comm.
Källvegetation
Vegetation of Springs
Massesamt ällen inkl. dråpåverkade
Moss Communities Including those Influenced by Fen Soaks
Skogbevuxna ristuvor
Forest Hummocks
Skoglösa ristuvor
Hummocks without Forest
Fastmattor
Lawns
Mjukmattor
Carpets
Lösbottensamhällen
Mud-bottom Communities
Bar torv & öppet vatten
Naked Peat & Open Water
Fastmark
Mineral Ground
Källa
Spring
Slukhål
Swallow-hole
Bäck
Streem
Stig
Path
Rågång
Boundary-clearing

Vegetationskarta
över
Skattlösbergs Stormosse
Grangärde socken, Dalarna
Vegetation Map of the Mire Skattlosbergs Stormosse
Dalarna, Sweden
0 100 200 300 400 500 m
Efter fältrekognoscering och flygbilder
uppgjord 1948 av
Gunnel & Hugo Sjörs
Specialområdet
Special area
Mosse
Moss
Kärr
Fen
Nätdrågkomplex
Soak Networks
Skogbevuxna ristuvsamhällen
Forest Hummock Communities
Skoglösa ristuvsamhällen
Hummock Communities without Forest
Fastmattsamhällen
Lawn Communities
Mjukmattsamhällen
Carpet Communities
Lösbottensamhällen & oppet vatten
Mud-bottom Communities & Open Water
Skogskärr
Forest Fen Communities
Fastmark
Mineral Ground
Back
Stream
Slukhål
Swallow-hole
Stentjärn
Puukkolam
Slaktmossen
Lommelam
Lamaslam
Trindmossen
Trind-
moss-
karis
Laxbäcken
Skinnartjärn
Klosstjärn
Algmossen
N
Lövmossen
Digelskyttmossen
Digelskyttbacken
eller Svensksjoan

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